

1 1. A safety restraint apparatus for protecting occupants of a vehicle, the apparatus
2 comprising:

3 a first cushion portion having deflated and inflated configurations, the first cushion
4 portion being adapted to receive gas from a source of pressurized gas;

5 a second cushion portion having deflated and inflated configurations; and

6 a first sail portion connected between the first and second cushion portions, the first
7 sail portion being adapted to provide passage of gas from the first cushion portion into the
8 second cushion portion.

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10 2. The apparatus of claim 1, wherein the first cushion portion is positioned
11 proximate a first lateral surface of the vehicle in the inflated configuration, so as to protect
12 an occupant of a front seat of the vehicle from lateral impact.

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14 3. The apparatus of claim 1, wherein the second cushion portion is positioned
15 proximate a second lateral surface of the vehicle in the inflated configuration, so as to protect
16 an occupant of a rear seat of the vehicle from lateral impact.

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18 4. The apparatus of claim 1, wherein the first cushion portion comprises a strut
19 anchored between opposite sides of the first cushion portion so as to limit expansion of the
20 first cushion portion in a lateral direction.

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22 5. The apparatus of claim 4, wherein the first cushion portion comprises a plurality
23 of struts anchored between opposite sides of the first cushion portion so as to limit expansion
24 of the first cushion portion in a lateral direction.

1 6. The apparatus of claim 5, wherein the second cushion portion comprises a
2 plurality of struts anchored between opposite sides of the second cushion portion so as to
3 limit expansion of the first cushion portion in a lateral direction.

4
5 7. The apparatus of claim 1, wherein the second cushion portion comprises a strut
6 anchored between opposite sides of the second cushion portion so as to limit expansion of
7 the first cushion portion in a lateral direction.

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9 8. The apparatus of claim 1, wherein the first cushion portion is fabricated
10 separately from the sail portion.

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12 9. The apparatus of claim 8, wherein the second cushion portion is fabricated
13 separately from the sail portion.

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15 10. The apparatus of claim 9, wherein the first cushion portion comprises a first sail
16 port, a first end of the first sail portion being attached inside the first sail port.

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18 11. The apparatus of claim 10, wherein the second cushion portion comprises a
19 second sail port, a second end of the first sail portion being attached inside the second sail
20 port.

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22 12. The apparatus of claim 11, wherein the first sail portion is attached to the first
23 and second sail ports by an attachment method chosen from the group consisting of sewing,
24 RF welding, chemical bonding, and adhesive bonding.

1 13. The apparatus of claim 12, wherein the first sail portion is RF welded to the first
2 and second sail ports.

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4 14. The apparatus of claim 11, wherein the first sail portion forms a substantially
5 gastight seal with the first and second sail ports, thereby maintaining the first and second
6 cushion portions substantially in the inflated configuration during a rollover of the vehicle.

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8 15. The apparatus of claim 1, wherein the first and second cushion portions each
9 comprise a polymer coating covering at least a portion of an inner surface of the first and
10 second cushion portions.

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12 16. The apparatus of claim 15, wherein the first sail portion comprises a polymer
13 coating covering at least a portion of an outer surface thereof.

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15 17. The apparatus of claim 16, wherein the polymer coatings of the first and second
16 cushion portions and the first sail portion comprise a urethane-based substance.

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18 18. The apparatus of claim 17, wherein portions of the polymer coatings of the first
19 and second cushion portions are RF welded to mating portions of the polymer coating of the
20 first sail portion.

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22 19. The apparatus of claim 1, further comprising:
23 a third cushion portion having deflated and inflated configurations; and
24 a second sail portion connected between the second and third cushion portions, the
25 second sail portion being adapted to provide passage of gas from the second cushion portion
26 into the third cushion portion.

1 20. The apparatus of claim 19, wherein the third cushion portion is positioned
2 proximate a third lateral surface of the vehicle in the inflated configuration, so as to protect
3 an occupant of an extra seat of the vehicle from lateral impact.

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5 21. The apparatus of claim 20, wherein the third cushion portion and the second sail
6 portion are each fabricated separately from each other and from the first cushion portion, the
7 second cushion portion, and the first sail portion.

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9 22. The apparatus of claim 21, wherein the second sail portion is RF welded to the
10 second and third cushion portions.

11
12 23. The apparatus of claim 22, wherein the second sail portion forms a substantially
13 gastight seal with the second and third cushion portions, thereby maintaining the second and
14 third cushion portions substantially in the inflated configuration during a rollover of the
15 vehicle.

1 24. A safety restraint apparatus for protecting occupants of a vehicle, the apparatus
2 comprising:

3 a first cushion portion having deflated and inflated configurations, the first cushion
4 portion being adapted to receive gas from a source of pressurized gas, the first cushion
5 portion further being positioned proximate a first lateral surface of the vehicle in the inflated
6 configuration, so as to provide protection from lateral impact;

7 a second cushion portion having deflated and inflated configurations, the second
8 cushion portion being positioned proximate a second lateral surface of the vehicle in the
9 inflated configuration, so as to provide protection from lateral impact;

10 a first sail portion connected between the first and second cushion portions, the first
11 sail portion being attached to the first and second cushion portions in substantially gastight
12 fashion to provide passage of gas from the first cushion portion into the second cushion
13 portion; and

14 wherein the first sail portion is fabricated separately from the first and second
15 cushion portions, the first sail portion being attached to the first and second cushion portions.
16

17 25. The apparatus of claim 24, wherein the first and second cushion portions each
18 comprise a polymer coating covering at least a portion of an inner surface of the first and
19 second cushion portions, the polymer coatings of the first and second cushion portions each
20 being RF welded to a corresponding polymer coating on an outer surface of the first sail
21 portion.
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1 26. A safety restraint apparatus for protecting occupants of a vehicle, the apparatus
2 comprising:

3 a source of pressurized gas;

4 a first cushion portion having deflated and inflated configurations, the first cushion
5 portion being adapted to receive gas from the source, the first cushion portion being
6 positioned proximate a first lateral surface of the vehicle in the inflated configuration, so as
7 to protect an occupant of a front seat of the vehicle from lateral impact; and

8 a supply tube connected between the first cushion portion and the source and
9 adapted to provide a substantially unrestricted flow of gas therebetween, the supply tube
10 being fabricated separately from the first cushion portion and formed of a substantially
11 flexible material.

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13 27. The apparatus of claim 26, wherein the supply tube is attached to the first
14 cushion portion by an attachment method chosen from the group consisting of sewing, RF
15 welding, chemical bonding, and adhesive bonding.

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17 28. The apparatus of claim 27, wherein the first cushion portion comprises a
18 polymer coating covering at least a portion of an inner surface of the first cushion portion.

19
20 29. The apparatus of claim 28, wherein the supply tube comprises a polymer coating
21 covering at least a portion of an outer surface of a first end of the supply tube.

22
23 30. The apparatus of claim 29, wherein the polymer coatings of the first cushion
24 portion and the supply tube comprise a urethane-based substance.

1 31. The apparatus of claim 30, wherein a portion of the polymer coating of the first
2 cushion portion is RF welded to a mating portion of the polymer coating of the supply tube.

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4 32. The apparatus of claim 26, wherein the first cushion portion further comprises
5 a tube port adapted to provide an interior surface sized to received a first end of the supply
6 tube.

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8 33. The apparatus of claim 32, wherein the tube port is attached to the first end of
9 the supply tube in substantially gastight manner, thereby maintaining the first cushion
10 portion substantially in the inflated configuration during a rollover of the vehicle.

11
12 34. The apparatus of claim 33, wherein the first cushion portion and the supply tube
13 are substantially constructed of different materials.

1 35. A method for manufacturing a safety restraint apparatus for a vehicle, the
2 method comprising:

3 providing a first cushion portion adapted to receive and retain pressurized gas;
4 providing a second cushion portion adapted to receive and retain pressurized gas;
5 providing a first sail portion adapted to permit passage of gas between first and
6 second ends of the first sail portion; and
7 connecting the first sail portion to the first and second cushion portions to form an
8 integral safety restraint apparatus.

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10 36. The method of claim 35, further comprising anchoring a first strut between
11 opposite sides of the first cushion portion and anchoring a second strut between opposite
12 sides of the second cushion portion so as to limit expansion of the first and second cushion
13 portions in a lateral direction.

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15 37. The method of claim 35, further comprising providing a first sail port in the first
16 cushion portion and a second sail port in the second cushion portion.

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18 38. The method of claim 37, wherein connecting the first sail portion to the first and
19 second cushion portions comprises attaching a first end of the first sail portion inside the first
20 cushion port and attaching a second end of the first sail portion inside the second cushion
21 port.

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23 39. The method of claim 38, wherein the first and second ends of the first sail
24 portion are attached to the first and second cushion ports by an attachment method chosen
25 from the group consisting of sewing, RF welding, chemical bonding, and adhesive bonding.
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1 40. The method of claim 35, further comprising forming a polymer coating covering
2 an inner surface of each of the first and second cushion portions.

3
4 41. The method of claim 40, further comprising forming a polymer coating covering
5 an outer surface of a first end of the first sail portion and an outer surface of a second end of
6 the first sail portion.

7
8 42. The method of claim 41, wherein the polymer coatings of the first and second
9 cushion portions and the first sail portion comprise a urethane-based substance.

10
11 43. The method of claim 42, wherein connecting the first sail portion to the first and
12 second cushion portions comprises RF welding portions of the polymer coatings of the first
13 and second cushion portions to mating portions of the polymer coatings of the first and
14 second ends of the first sail portion.

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16 44. The method of claim 35, wherein the first sail portion is fabricated substantially
17 of a material different from that used to substantially fabricate the first and second cushion
18 portions.

19
20 45. The method of claim 35, further comprising:
21 providing a third cushion portion adapted to receive and retain pressurized gas;
22 providing a second sail portion adapted to permit passage of gas between first and
23 second ends of the second sail portion; and
24 connecting the second sail portion to the second and third cushion portions.

1 46. The method of claim 45, wherein connecting the second sail portion to the
2 second and third cushion portions comprises RF welding a first end of the second sail portion
3 to the second cushion member and RF welding a second end of the second sail portion to the
4 third cushion member, such that the third cushion portion may receive gas from the second
5 cushion portion.

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7 47. The apparatus of claim 46, wherein the second sail portion and the third cushion
8 portion are configured to maintain a substantially gastight seal such that the third cushion
9 portion is maintained substantially in the inflated configuration during a rollover of the
10 vehicle.